VALUES AND ECONOMIC IMPACTS OF SALMON AND STEELHEAD PRODUCTION

Background - Economic Value Concepts

Broadly speaking, salmon, steelhead and trout have economic values related to recreational and commercial uses as well as other values not tied directly to use. Values for fish are associated with recreational and commercial fisheries. Most likely there are also some recreational values associated with nonconsumptive uses, such as the viewing and photographing fish.

Consider how we might value recreational fishing. First, you can measure the financial activity that is associated with the money people spend to buy goods and services on their fishing trips. Expenditures at businesses that provide goods and services produce direct and indirect effects on business revenues, jobs and personal income in the local area and at the state level. People's purchases initiate cash flows having direct effects on businesses, and, through the so-called "multiplier process", on income and employment in the general economy. This approach to valuing recreational fishing is the expenditure and <u>economic impact</u> approach.

A second way to measure the value of fish and fishing takes a somewhat different perspective. People spend money to go sport fishing because they enjoy doing it. Fishing has a personal or *user value* to people, just as any other leisure activity or market good they purchase. In most cases, people expect that a product or activity they spend money on will be worth at least as much, and probably more than what they spend to procure it. Thus people have a "total willingness to pay" for a product or activity equal to or greater than what they actually spend. The difference between total willingness to pay and what is actually spent is called "consumer surplus" or "net economic value". Valuing fishing from the user's point of view is the <u>economic value</u> approach.

Most products of land and water use, such as agricultural commodities, or privately and publicly owned timber are priced in the market places of the nation's (or world's) economy. Conflicting demands for these products are resolved in the market, and prices are established when users bid against one another for the available supply. Thus, it is conceptually, if not actually, easy to measure the economic impacts and economic values associated with commodity production, because market price and production cost information tell us how society values these products.

This is not often true for fish and associated recreational activities. In the United States, the Public Trust Doctrine assigns ownership of fish resources to State or Federal Government (Loomis, et. al., 1984). Rights to use or appreciate these resources are seldom sold in a competitive market. The economic value of fish and associated recreation is a nonmarket (or non-financial) value. No market prices exist to suggest directly how society as consumers values these resources, or to signal society as a resource producer, how much should be supplied. Therefore, economic value is difficult to assess without market price information to make it easier to determine fully what people are willing to pay.

People seem to understand intuitively the economic impact approach to valuing salmon, steelhead and trout. But, the "economic value" or "consumer surplus" concept is difficult to understand as a real economic benefit, because it represents money that has not been collected by anyone (such as a producer businesses or the government) as payment for the benefit received. That no one actually charges consumers the full amount they would be willing to pay to use these resources does not make the consumer surplus any less real. In concept, uncollected moneys can be thought of as income that remains to be used by the consumer for other purposes.

The two economic dimensions (impacts and values) for commercial salmon fishing are nearly analogous to the concepts for assessing recreational fishing. Using commercial fish landings and market data, and information on salmon fishing and processing businesses, it is possible to estimate the revenues of harvesters, and the economic impact on total personal income at the coastal or state level. There are also economic values, such as producer and consumer surpluses associated with the commercial production and consumer consumption of salmon. Producer surplus is the difference between the amounts producers receive in payment and the "opportunity cost" of inputs.

To complicate matters further, there also are important nonuse or "passive use" economic values associated with our *wild* salmon, steelhead and trout:

- Existence value, a willingness to pay just to know the a fish stock exists.
- Option value, an amount people would be willing to pay to insure the availability of recreational fishing opportunity for themselves in the future.
- Bequest value, a willingness to pay for maintaining salmon, steelhead and trout for future generations.

There is disagreement among economists about whether or not these nonuse or "passive use" values can be measured accurately (Diamond and Hausman, 1994; Hanneman, 1994; Portnoy, 1994). Regardless, they are reflected qualitatively in our expressions of social and cultural values, and laws on threatened and endangered species.

Benefit-cost analysis generally involves economic value. Benefit-cost analysis typically involves comparison of the net economic values or economic *surplus* of a proposed or existing government project to the cost of the project. It can be used to compare the net benefits of one resource management option to alternative options, or to investigate how the benefits of fish production compare to the costs of using essential inputs.

In contrast, the economic impact approach is used to estimate the contribution of fish and fisheries to the financial economy (business revenues, jobs and personal income) of a local community, county, multi-county region or state. Sometimes this approach is useful when making decisions about economic development alternatives. Analyses based on economic impact measures involve the use of economic input-output models. These analyses are most relevant at the level of local, county or multi-county economies (e.g., the coastal Oregon economy). The analyses may also be used to investigate the economic impacts of policy changes on the financial well-being of particular industries or types of business.

Some economists refer to "economic impact analysis" as a broad scope analysis that considers every conceivable economic variable, including tax revenues, public service requirements, income transfers and so on (Anderson and Settle, 1982). We use the term economic impact more narrowly to refer to the impact of an economic activity on either the gross output, jobs or, perhaps most interestingly, on the personal income associated with the activity.

Recreational Fishing Values for Salmon and Steelhead

Except for a few updates from more recent pieces, this section is taken directly from Johnson (1994), which summarized most of the studies pertaining to salmon and steelhead recreational fishing values. There have been a number of studies of the economic value of salmon and steelhead, in both ocean and inland fisheries. Most of the journal literature is concerned with theoretical and methodological issues related to estimating nonmarket economic values, but many also contain an empirical application to a particular fishery resource.

Studies that have been done on Oregon fisheries include the early study by Brown, Singh, and Castle (1965) on salmon and steelhead fishing in Oregon, and the follow-up studies by Brown and his colleagues (Brown, Larson, Johnston, and Wahle, 1976; Sorhus, Brown, and Gibbs, 1981). The 1977 data collected by Sorhus, et al (1981), has since been used by Strong (1983), Loomis (1989), and Loomis, Provencher and Brown (1990) in other applications.

Other Oregon fishery studies include the study by Johnson, Shelby, and Moore (1989) on the Chetco River winter fishery, studies by Meyer (1982), Meyer, Brown, and Hsiao (1983), and Olson, Richards, and Scott (1990) on the Columbia River fisheries, and the work by Bergland and Brown (1988) on ocean salmon fishing.

None of the previous studies provide exactly the information that is currently needed for making management decisions about specific hatcheries. However, they do provide reference points for comparison. Studies from other areas also provide a wealth of information on the theory and methods of economic valuation of fishery resources in general. Table 1 lists the economic values from selected studies in the Pacific Northwest. Values in Johnson (1994) were standardized to a value per angler day basis in 1992 dollars, and have been updated to 2002 dollars here.

Table 1. Salmon and Steelhead Values (per angler day) - Selected Studies

Steelhead

LOCATION	REF; DATE	METHOD	$1992 per day	$2002 per day
Idaho	Loomis & Sorg, 1985	TCM	19.60	23.62
Oregon	Strong;1983	TCM	23.59	28.42
Idaho	Loomis & Sorg, 1985	CVM	27.83	33.53
Oregon	Brown, Chou-Yang & Richards, 1983	TCM	29.82	35.93
Oregon	Brown, Sorhus & Gibbs;1980	TCM	30.87	37.20
Rogue River	Olsen, et al;1994	CVM	25.90; 33.30	31.21; 40.12
Oregon	Loomis;1986	TCM	37.35	45.00
OR/WA	Olsen, Richards & Scott;1990	CVM	37.63	45.34
OR/WA	Riely;1988??	TCM	38.07	45.87
Columbia R.	Olsen, Richards & Scott;1990	CVM	50.18	60.46
Oregon	Meyer, Brown & Hsiao;1983	TCM	59.68	71.91

Salmon

LOCATION	REF; DATE	METHOD	$1992 per day	$2002 per day
Oregon	Loomis;1986	TCM	18.07	21.77
Oregon	Brown, Sorhus & Gibbs;1980	TCM	21.95	26.45
Rogue River	Olsen, et al;1994	CVM	25.80; 36.80	31.09; 44.34
OR/WA	Riely;1988??	TCM	27.92	33.64
Alaska	Hanneman & Carson;1991	CVM	32.34 - 59.99	38.97 – 72.28
OR/WA	Olsen, Richards & Scott;1990	CVM	35.43	42.69
B.C.	Cameron & James;1987b	CVM	49.96	60.20
Columbia R.	Olsen, Richards & Scott;1990	CVM	53.36	64.29
Oregon	Meyer, Brown & Hsiao;1983	TCM	60.36	72.73

(Continued)

Table 1. Salmon and Steelhead Values (per angler day)- Selected Studies (Continued)
Ocean Salmon

LOCATION	REF; DATE	METHOD	$1992 per day	$2002 per day
B.C.	Cameron & James;1987b	CVM	27.68	33.35
Oregon	Riely;1988??	TCM	32.37	39.00
Washington	Crutchfield & Schelle;1978	CVM	34.85	41.99
Oregon	Bergland & Brown;1988	TCM	46.49	56.02
Oregon	Meyer, Brown & Hsiao;1983	TCM	53.29	64.21
OR/WA	Olsen, Richards & Scott;1990	CVM	55.54	66.92
Washington	Riely;1988??	TCM	76.15	91.75

Salmon and Steelhead (combined)

LOCATION	REF; DATE	METHOD	$1992 per day	$2002 per day
Oregon	Brown, Singh & Castle;1965	TCM	32.37	39.00
Oregon	Brown, et. al.;1976	TCM	47.71	57.49
Chetco	Johnson, Shelby & Moore;1989	CVM	31.31	37.72

The values for coastal salmon and steelhead range between about 20 and 70 dollars per angler day. The values for ocean salmon fishing range between about 30 and 90 dollars per angler day. Both types of economic models used in making these estimates, the travel cost model (TCM) and the contingent value model (CVM), have undergone methodological refinement over time, which makes it difficult to precisely compare estimates between studies.

A few studies report values for both salmon and steelhead (Table 2). These are interesting because they allow a comparison of salmon vs. steelhead values in situations where the study date and method are the same. In most of these studies, the value of steelhead angling is greater than the value of salmon angling.

Table 2. Salmon vs. Steelhead Values (per angler day) - Selected Studies – 1992 $ (2002$)
Salmon Fishing Values vs. Steelhead Fishing Values

LOCATION	REF; DATE	SALMON	STEELHEAD
Oregon	Brown, Sorhus & Gibbs;1980	21.95 (26.45)	30.87 (37.20)
Rogue	Olsen, et al;1994	25.80; 36.80 (31.09; 44.34)	25.90;33.30 (31.21; 40.12)
OR/WA	Riely;1988??	27.92 (33.64)	38.07 (45.87)
Idaho	Gordon, Chapman & Bjornn;1973	80.92 (97.50)	159.12 (191.73)
Oregon	Loomis;1986	18.07 (21.77)	37.35 (45.00)
OR/WA	Olsen, Richards & Scott;1990	35.43 (42.69)	37.63 (45.34)

Several of the studies listed in Tables 1 and 2 above used angler trip values and catch rates from the surveys to project average values per fish caught. Table 3a shows these average values per fish caught. The numbers represent the average net willingness to pay of surveyed anglers per fishing trip divided by the average reported catch on the trip. The reader is advised to remember that it is the entire fishing experience that is the source of the value, so these average values per fish caught must be interpreted accordingly.

Table 3a. Salmon and Steelhead Values ($) - Selected Studies
Values Stated in Terms of Average Value per Fish Caught

LOCATION	REF; DATE	Average Value per Fish Caught ($)	Average Value per fish Caught (2002$)
OR/WA	Olsen, Richards & Scott;1990	Ocean salmon 41.61 Coastal salmon 36.72 Coastal steelhead 64.06	Ocean salmon 53.22 Coastal salmon 46.97 Coastal steelhead 81.93
Rogue	Olsen, et al;1994	Summer steelhead 82.00 Fall chinook 75.60 Winter steelhead 44.20 Spring chinook 63.60	Summer steelhead 104.88 Fall chinook 96.69 Winter steelhead 56.53 Spring chinook 81.34

These same studies also contained estimates of anglers' net values for a doubling of their reported catch (or going from 0 fish to 1 fish caught) on their last fishing trip. These "marginal" values represent anglers' average net willingness to pay for a catch-enhanced fishing trip.

Table 3b. Salmon and Steelhead Values ($) - Selected Studies
Values Stated in Terms of Marginal Value per Fish Caught on Last Trip

LOCATION	REF; DATE	Marginal Value per Fish Caught ($)	Marginal Value per fish Caught (2002$)
OR/WA	Olsen, Richards & Scott;1990	Ocean Salmon 25.26 Coastal salmon 14.81 Coastal steelhead 24.96	Ocean Salmon 30.44 Coastal salmon 17.85 Coastal steelhead 30.08
Rogue	Olsen, et al;1994	Summer steelhead 26.80 Fall chinook 16.50 Winter steelhead 18.70 Spring chinook 17.70	Summer steelhead 32.29 Fall chinook 19.88 Winter steelhead 22.53 Spring chinook 21.33

Economic Impact Considerations

The purpose of this section is to describe the financial impacts on coastal and state economies in terms of the personal income impacts of associated commercial and recreational fishing activities that depend on salmon and steelhead production. Angler day economic impact estimates by fishery and species category are based on estimates in the Oregon Angler Survey (Research Group, 1991) and estimates used by the Pacific Fishery Management Council in its annual review of salmon fisheries.

The information on economic impacts described in this section are based on materials developed by Dr. Hans Radtke as part of the Oregon Angler Survey and Economic Study (The Research Group, 1991). Economic input/output (I/O) models are used to estimate the impact of resource changes or to calculate the contributions of an industry to a regional economy. The basic premise of the input/output framework is that each industry sells its output to other industries and final consumers, and in turn purchases goods and services from other industries and primary factors of production.

Input/output models can be constructed using surveys of state or regional economies. The estimates of the impacts of fish and fishing utilize one of the best known secondary input/output models available. The U.S. Forest Service originally developed a computer system called IMPLAN which can be used to construct county or multi-county I/O models for any region in the U.S. The regional I/O models are derived from technical coefficients of a national I/O model and localized estimates of total gross outputs by sectors. IMPLAN adjusts the national level data to fit the economic composition and estimated trade balance of a chosen region.

Figure I demonstrates how local re-spending of an expenditure by individuals and businesses creates this multiplier effect. The process begins when a dollar enters the local economy, in this case as the result of an export sale (column A). The dollar will be re-spent by the exporting firm in order to purchase inputs (goods, services, labor, taxes, profits, etc.) to meet the increased export demand (column B). Sixty cents of the dollar will be received by local businesses and households, but $0.40 will leak out in the form of non-local purchases. Thus, in addition to the initial dollar, business re-spending has generated an additional $0.60 of business activity within the economy. Of the $0.60 that is locally received, $0.38 will be re-spent within the county, and the rest ($0.22) will leak out (column C). This process continues until the amount remaining in the local economy is negligible (columns D, E, F). Thus, greater leakage at any round of re-spending leads to a smaller multiplier.

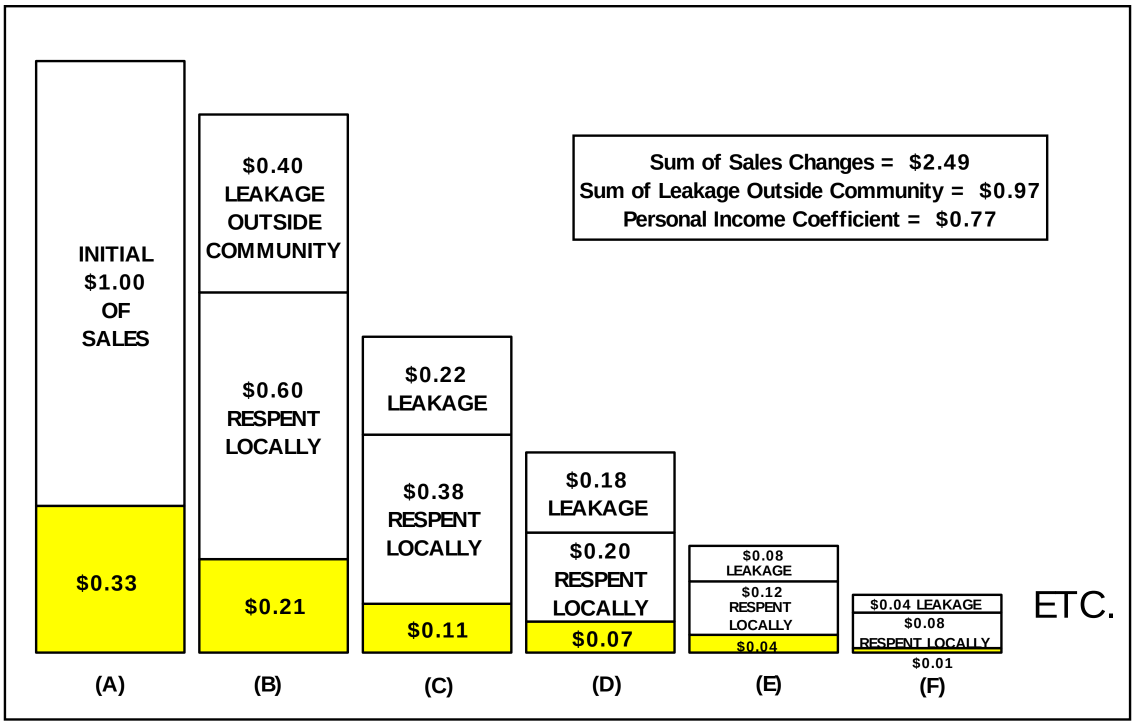
In order to determine the total multiplier value, the initial dollar is added to the sum of the local re-spending. In this example, the output multiplier equals 2.49 ($1.00 initial change + 0.60 + 0.38 + 0.20 + 0.12 + 0.08 <u>and so on</u> until it approaches 2.49). Thus, $2.49 of business activity will be generated for each dollar that enters the local or regional economy.

The output (sales) multiplier calculates how much money is "stirred up" in an economy, but it does not mean that someone in the local area is making a wage or profit from this money. The differences between output multipliers and income coefficients are often confused, leading to misuse. It is important for decision-makers to know and understand what type of multiplier or coefficient is being used in the assessment of the economic impact of proposed policy decisions.

A more useful measure of the contribution of a sector's activity is the amount of personal income that is directly and indirectly generated from an increase in sales. The distribution of the amount of personal income generated by a change in economic activity is shown in Figure I. Local personal income generated is the shaded part of the output (sales) multiplier.

The "personal income coefficient" measures the income generated as a result of a change in sales. In the first round of export sales, $0.33 of local personal income is generated. The other $0.67 in the initial round goes to purchase supplies and services from other industries.

Figure I
Output (Sales) Multiplier And Personal Income Coefficient



Note: The shaded portion of the output (sales) that goes to households in terms of wages, salaries, and profits is called personal income.

These industries also create wages, salaries, and profits. As these sales work through the economy, a total of $0.78 of personal income is generated from every $1 of increase in sales. (Figure 1 only sums to $0.77 because the effects after the sixth round are not included in the example.)

The size of the personal income coefficient is largely determined by the amount of personal income generated by the first round. In an industry that is very labor intensive, the output (sales) multiplier may not be very large while the income coefficient is above average. On the other hand, if the industry goes through several transactions but is not very labor intensive throughout the process, the output (sales) multipliers may be large and the income coefficient small.

The amount that an angler spends in order to take part in a fishing trip has an impact on state or regional economies as well as local economies. For example, expenditures related to angling in the coastal area also generate income outside the area for several reasons. First, a portion of fishing trip expenditures are made near anglers' homes and en route to the fishing destination and thus generate income for those areas; second, income is also generated outside of the area because of "leakages" or purchases of the area economy from the larger state and regional economies. Thus, the angler who fished in the coastal area made expenditures which generated personal income in the state.

In the Oregon Angler Survey and Economic Study (Research Group, 1991) surveys were used to determine fishing expenditures. Local residents spend money in their communities while they participate in angling in a local area. If the angling opportunities were no longer available, these anglers may go to other areas to fish or may participate in other forms of recreation. For pure local or regional economic development purposes, the non-resident impacts should be considered as the primary measure of total regional economic impact resulting from a change in fishing opportunity. However certain businesses, such as tackle stores or restaurants close to the angling destination, will experience a direct gain or loss as a result of resource changes regardless of the origin of anglers. If residents choose to substitute other recreation activities, these businesses will certainly experience a loss in sales and income. It is therefore appropriate to use the economic impact of all anglers (residents and non-residents) as a measure of the effect on businesses in an area. It may be more appropriate to use the non-resident related expenditures as a way to estimate the regional aggregate long term economic development effect (created impacts) of additional or reduced opportunities.

Other modeling methodology assumptions in the study used to calculate the estimates of the personal income impacts in the Oregon Angler Survey's state level impact estimates were:

- All expenditure and personal income impacts were calculated on a per angler day basis. This means that all expenditures and impacts for the trip are attributed to the overall trip purpose being for fishing.

- Models show trip expenditures and associated personal income impacts prorated on a per angler day basis. Because equipment purchases are assumed not to vary directly with angler days, expenditures and impacts from equipment purchases are not included.

The survey collected expenditure data by residence area, water type, and species. Information was retrieved from this data set to estimate expenditure patterns and economic impacts for recreational fishing for trout, salmon and steelhead. We adjusted the estimates for inflation using the implicit price deflator for gross domestic product.

For purposes of this updated review, we present estimates of the personal income impacts per angler day of sport fishing.

Type of Angling (Species and water type)	Estimated state level personal income impact of trip expenditures per angler day (2002 $)
Steelhead	$44.26
Salmon, ocean (20% charter; 80% private)	$60.21
Salmon, inland	$43.65

Contributions of the commercial salmon fishery were based on the West Coast Fisheries Economic Assessment Model (FEAM) developed by Hans Radtke and William Jensen, which has been utilized by several fish resource management agencies. The model uses information on the costs of harvesting and processing businesses in major fisheries-dependent communities on the West Coast. This harvester and processor budget information is used in the model to estimate the economic impact of a specific fishery. The model also uses total inventory of the harvesting and processing sectors as a base. Disaggregated costs are multiplied by the appropriate IMPLAN derived *direct, indirect,* and *induced* income coefficients to arrive at estimates of total income impacts associated with landed fish products.

The estimated per fish income impacts of salmon landed in Oregon were based on the 2002 prices for chinook and for coho salmon:

	Ex-vessel Price Per Pound	State Income Impact Per Pound	State Income Impact Per Fish
Coho	$0.75	$1.85	$13.01
Chinook	$1.54	$3.13	$34.18

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Christopher N. Carter, Ph.D.
Staff Economist
Oregon Department of Fish & Wildlife
Revised July, 2003